North American Land Surface Albedo Dynamics from Landsat and MODIS/VIIRS

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Landsat Albedo

- North American Albedo for the MODIS/VIIRS era
- Concurrent approach (Shuai et al., 2011) links similar locations of MODIS(VIIRS) and Landsat to assign BRDFs to Landsat pixels
- Yanmin Shuai has just joined UMassBoston
- Current algorithm implementation efforts this year
  - Implementing processing chain improvements
  - Automating mosaicking, masking and sub-setting of daily MODIS inputs for linkage with Landsat scene
  - Overlapping processing to reduce impact of scene boundaries
  - Investigating use of WELD processing
  - Large area processing (limited thus far availability of MODIS V006)
    - MODIS V006 processing is underway
    - Daily MODIS BRDF (MCD43) is just about to be released
    - VIIRS BRDF/Albedo/NBAR algorithm is being tested

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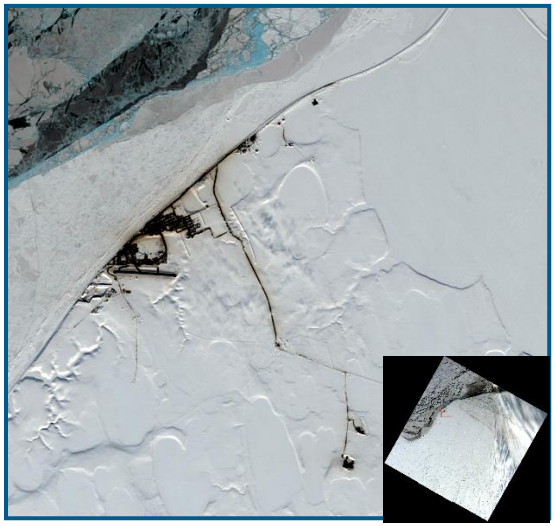
Current Algorithm

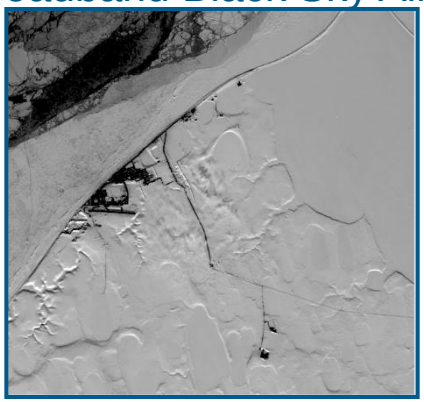
Barrow SURFRAD
Flux Site
Landsat 8
2014 DOY: 098

Surface Reflectance

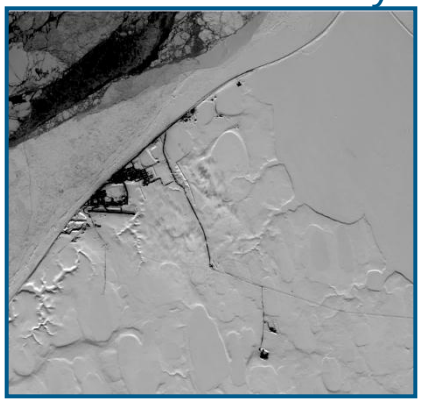


Primary Products

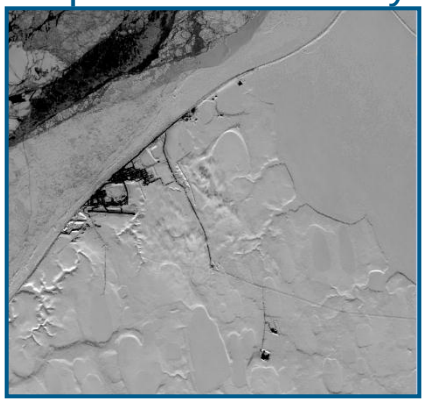
Broadband Black Sky Albedo



Broadband White Sky Albedo

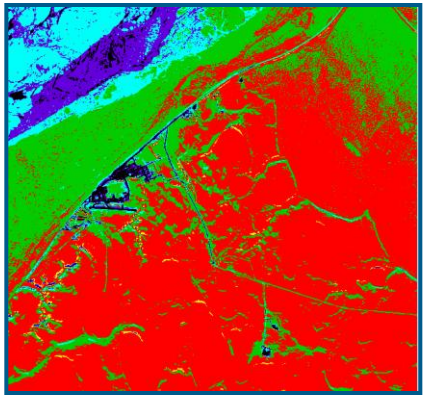


Full Expression Blue Sky Albedo

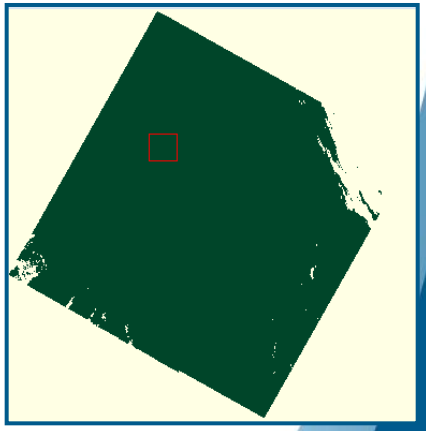


Ancillary Products

Classification File



Quality Flag File



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Current Evaluation Efforts:

- Established Narrow to Broadband coefficients (N2B) for L8
  - Convert the spectral albedos to the broadband albedos
    - used in surface energy models
    - measured at tower sites with paired pyranometers

- Established Full Expression Blue Sky Albedo algorithm for L8
  - Blue Sky (actual) albedo is a combination of Black Sky albedo and White Sky albedo as a function of atmospheric optical depth (incorporating multiple scattering)

- Validation of N2B and Blue Sky Albedo over tower sites
  - Spatially representative sites (including Sentinel-2A)
    - Sadly not the Finnish forested site

- Improved L8 radiometry and validation over snow
  - Establishing effects of land cover change on Albedo

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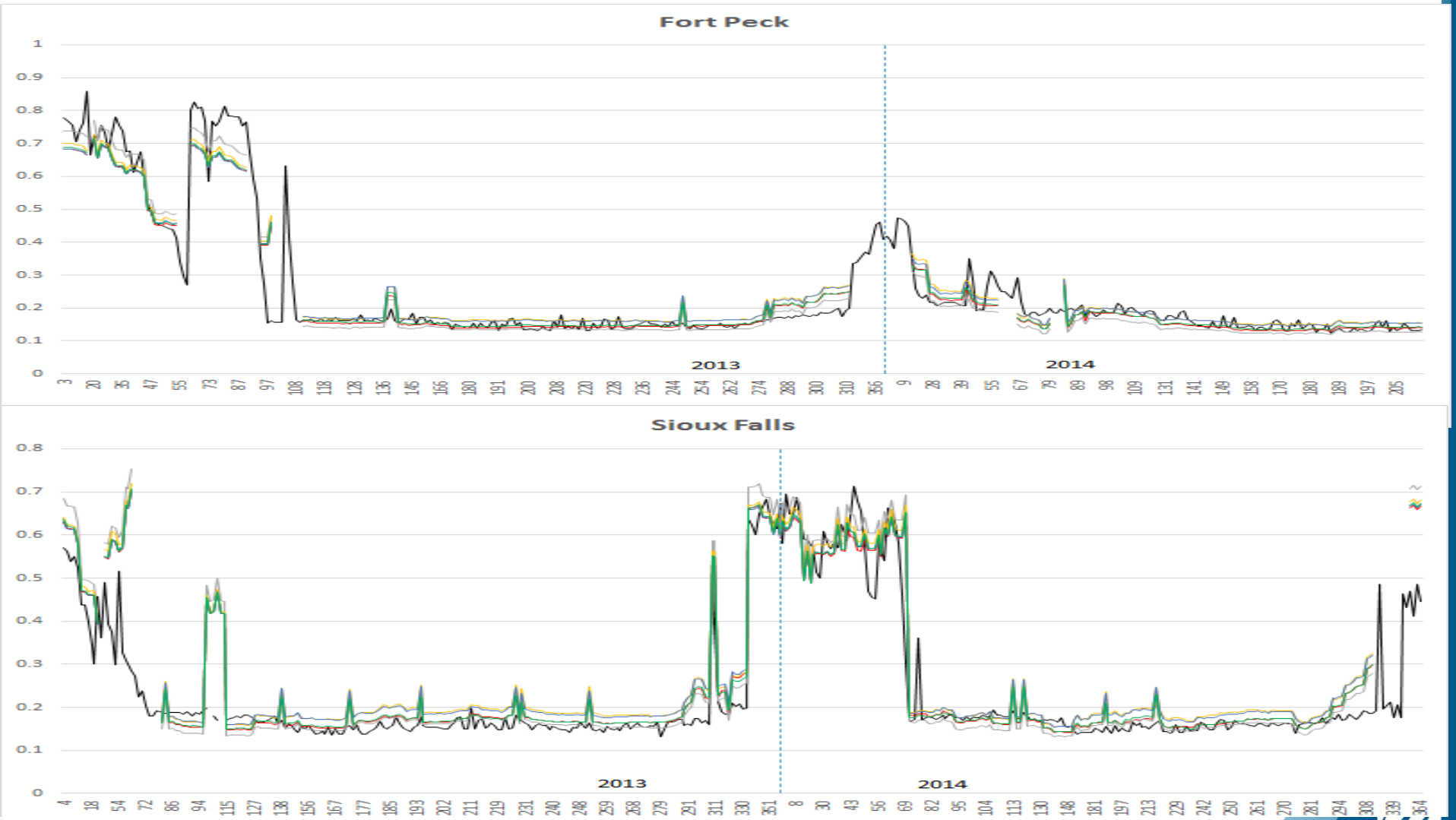
Generation of narrow to broadband conversion coefficients:

- Several Approaches investigated ●Hyperion ●AVIRIS
- ● Spectral Library (Snow/Snow Free/Combined Coefficients)



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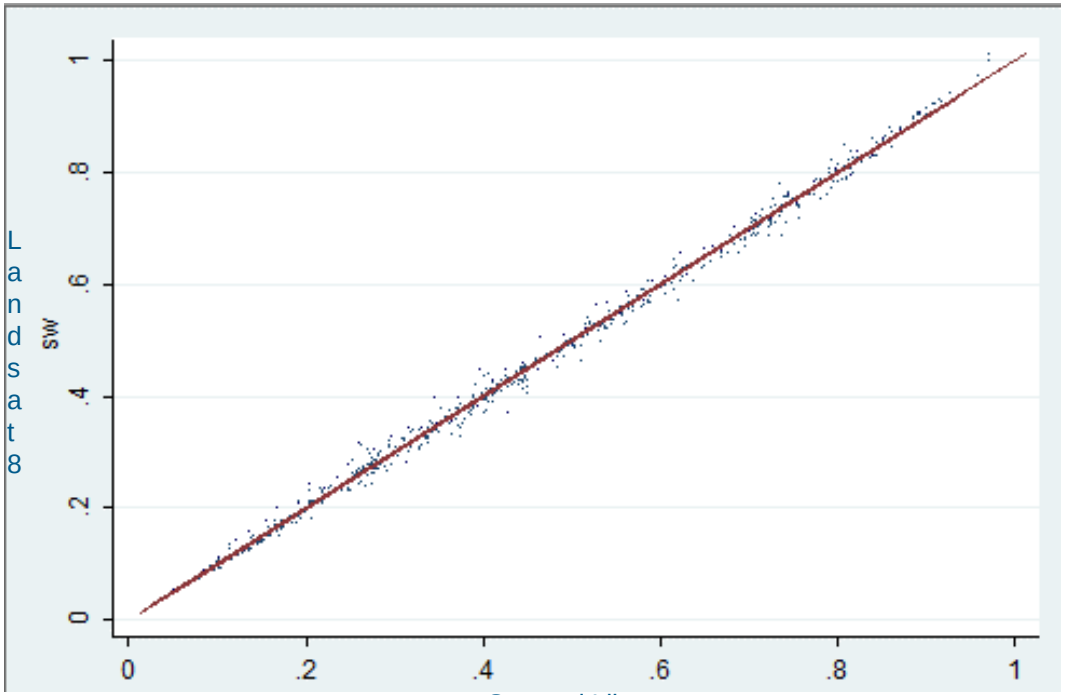
Narrow to Broadband Coefficients – Landsat 8 Spectral Library



Band	Coefficient
B2	0.245342
B3	0.050843
B4	0.180395
B5	0.308064
B6	0.133185
B7	0.052135
Constant	0.0011052

Source	SS	df	MS
Model	45.9689633	6	7.66149388
Residual	.138933101	737	.000188512
Total	46.1078964	743	.062056388

Number of obs = 744
F(6, 737) =40642.01
Prob > F = 0.0000
R-squared = 0.9970
Adj R-squared = 0.9970
Root MSE = .01373

sw	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
b2	.2453421	.0089632	27.37	0.000	.2277457	.2629386
b3	.050843	.0133251	3.82	0.000	.0246832	.0770027
b4	.1803945	.0086167	20.94	0.000	.1634783	.1973106
b5	.3080635	.0041681	73.91	0.000	.2998809	.3162462
b6	.1331847	.0058989	22.58	0.000	.1216041	.1447654
b7	.0521349	.005199	10.03	0.000	.0419283	.0623414
_cons	.0011052	.0011357	0.97	0.331	-.0011244	.0033348

R2 = 0.9970
RMSE- 0.01373

*Currently under validation

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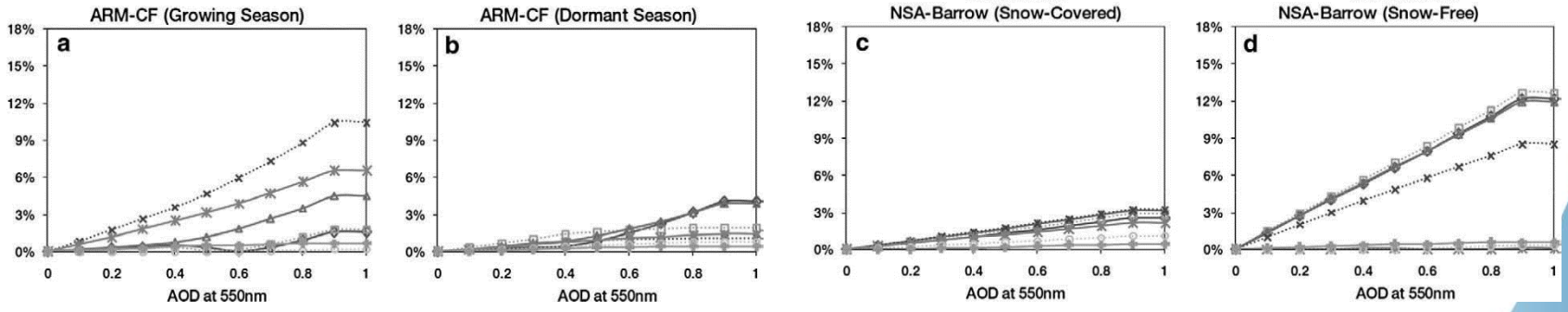
Generation of Full Expression Blue Sky Albedo

- Using method presented in Román et al, 2010
- MODTRAN generated pre-defined look up tables for all Landsat platforms
- Uses hierarchical MODIS Aerosol Optical Depth data, MOD08 (Remer et al, 2005)
  - Daily / 8-day / Monthly
  - Where no acceptable values found, fill value of 0.2
- Improved validation results over Isotropic blue sky albedo



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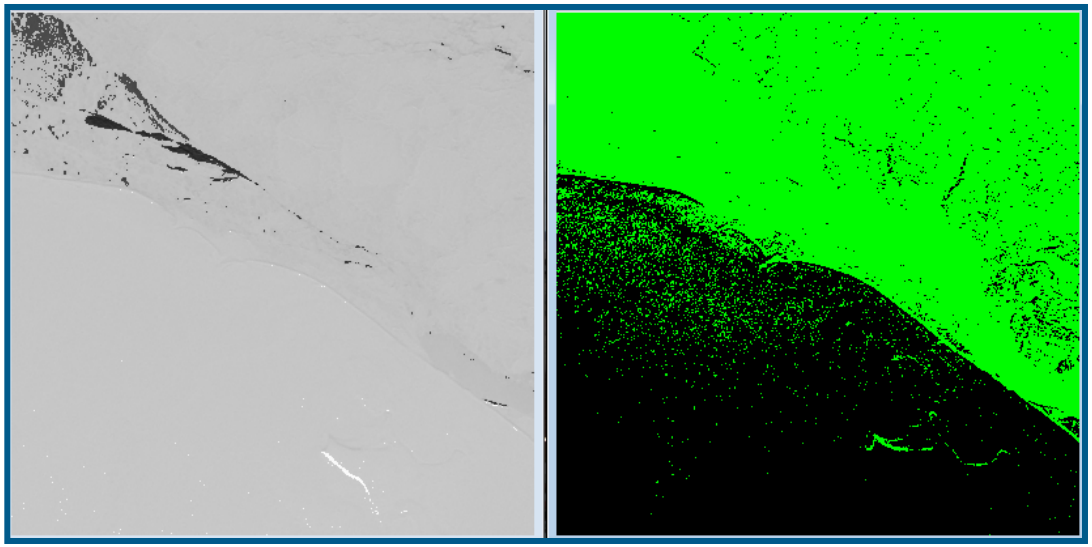
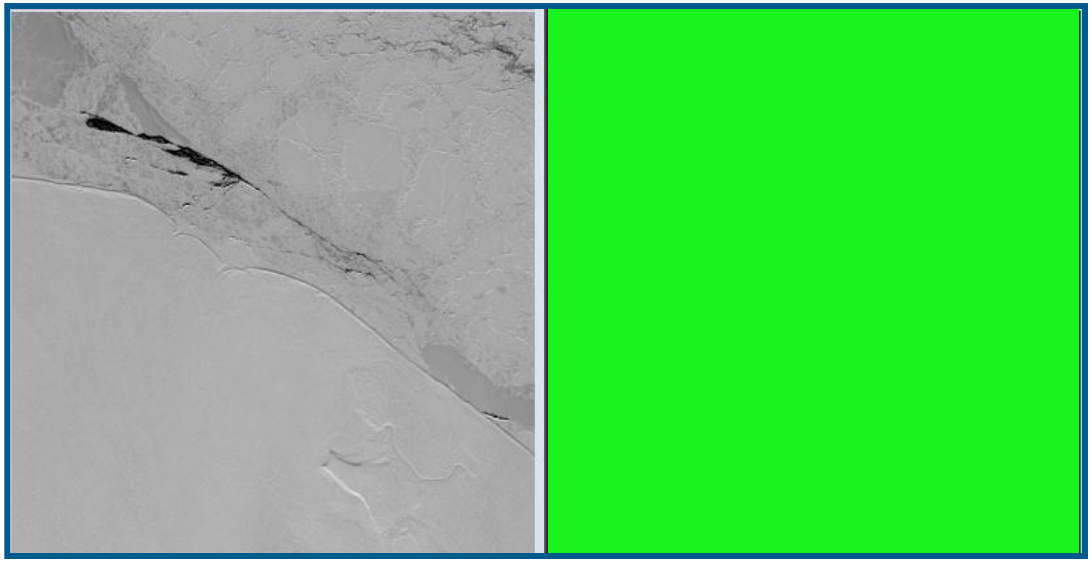
Full Expression Blue Sky Albedo of Landsat 7 and 8



Landsat 7

Full Expression Blue Sky Albedo
LE7079010
2014 DOY: 090

Green= Unsaturated values
Black = Saturated Values > 1.0



Landsat 8

Full Expression Blue Sky Albedo
LC8079010
2014 DOY: 098

Green= Unsaturated values
No saturated values

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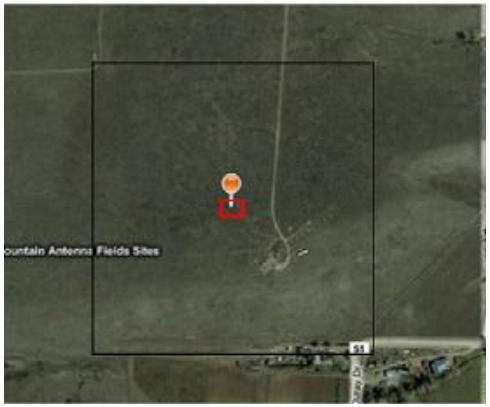
Validation of Landsat Blue Sky Albedo

Barrow, AK (BSRN)
Tundra

Imnavait, AK (AON)
Tussock/Tundra

Morgan Monroe State Forest, IN
(Ameriflux) Deciduous Broadleaf Forest

Table Mountain, CO (SURFRAD)
Grassland



Sioux Falls, SD (SURFRAD)
Grassland

Landcover	Forest		Grass/Agriculture		Tundra	
Season	Snow	Snow-Free	Snow	Snow-Free	Snow	Snow-Free
RMSE	0.0324	0.0137	0.0518	0.0225	0.0493	0.0319
BIAS	0.0239	0.0103	-0.0227	0.0098	-0.0153	0.0154

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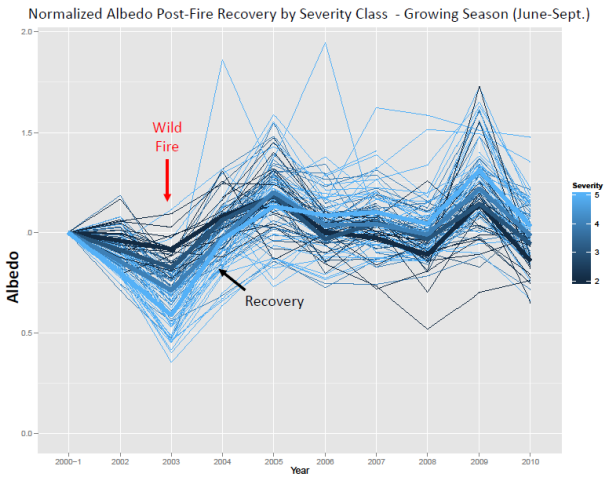
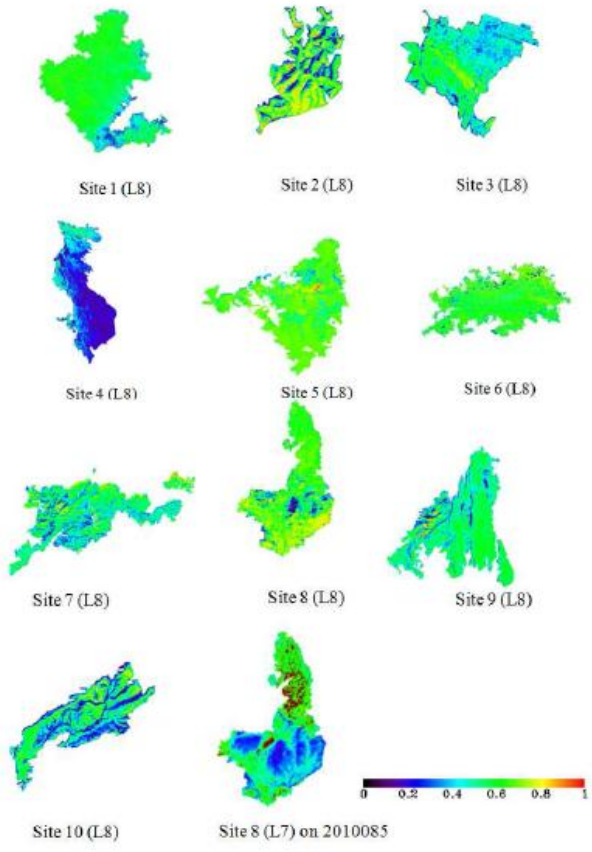
Current Landsat Projects include:

- Fire Recovery Albedos in Alaskan boreal regions
  - Focus on snow and winter albedo
  - Temporal dynamics
- Albedo as a tool for forest management protocols in New England forests
- Albedos related to carbon stock management in Pacific Northwest



Burn Scar recovery dynamics as function of burn severity



Within scar Landsat 8 albedo variability

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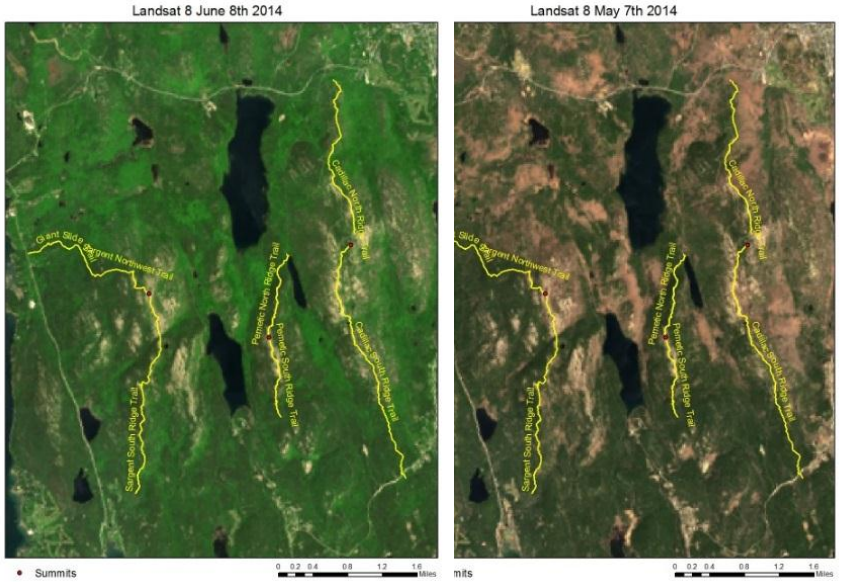
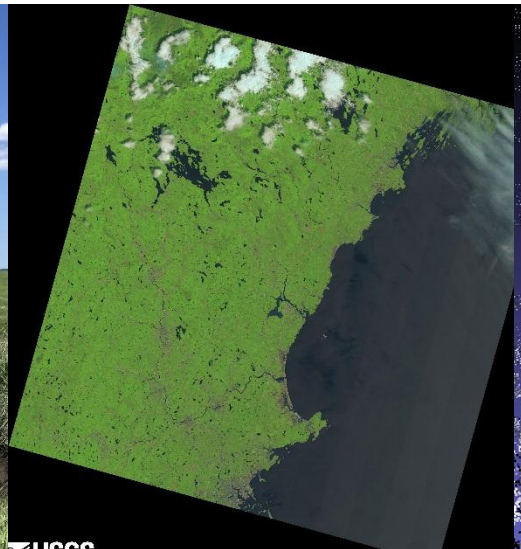
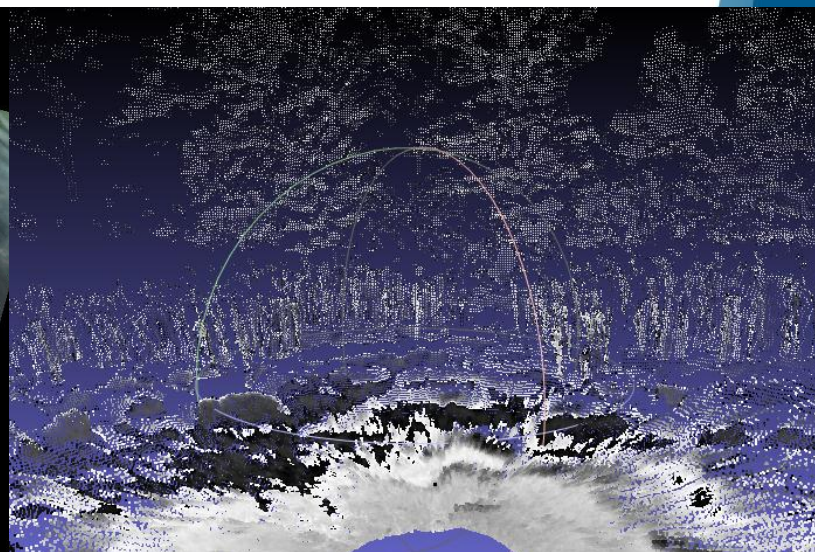
Current Landsat Projects include:

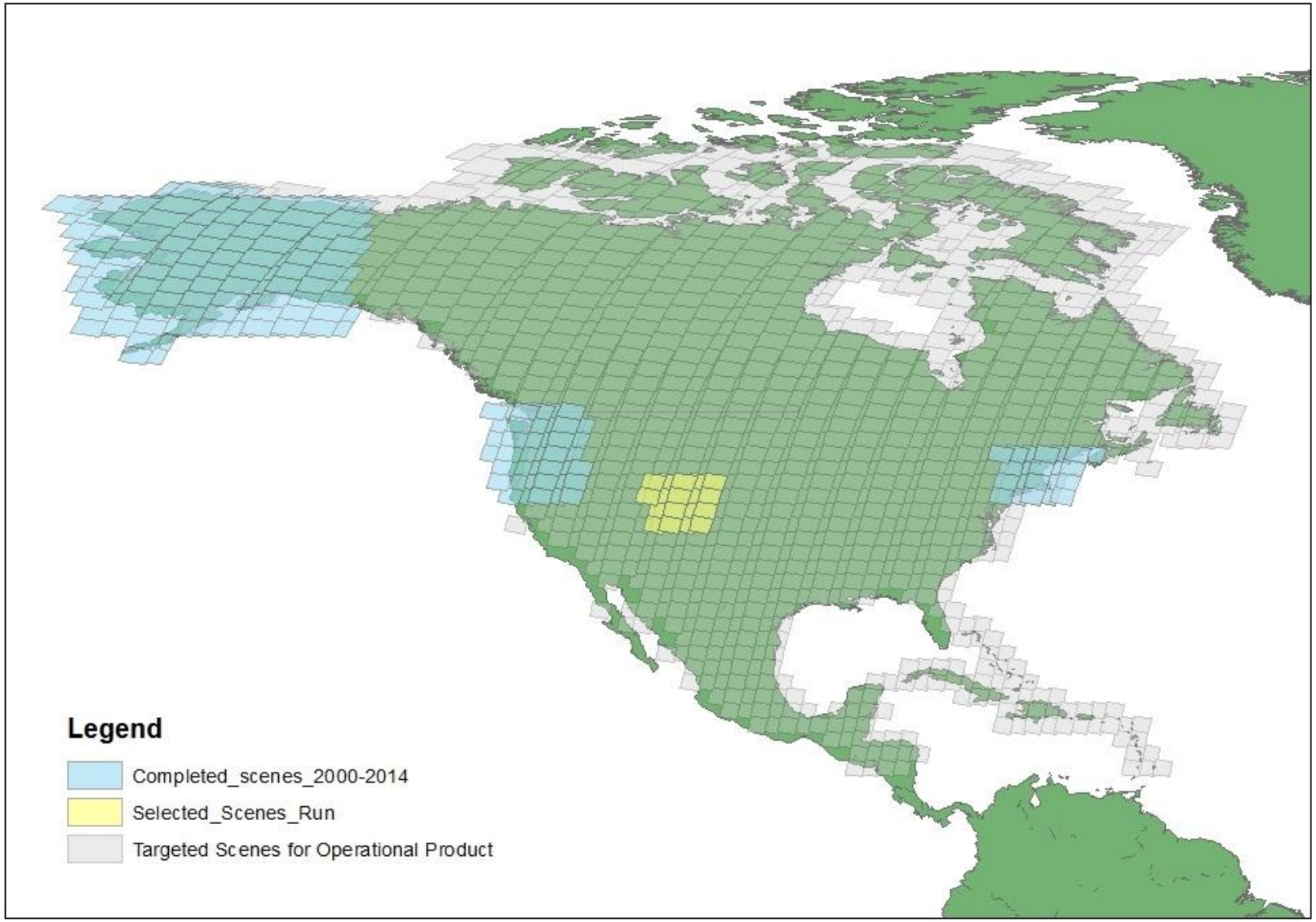
- Slope Phenology, Acadia Maine
  - Incorporating STARFM
- Characterizing Salt Marsh Dynamism with Landsat 8, Terrestrial Lidar and G-LiHT
  - Plum Island LTER







Status of North American Albedo Product



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